

<http://www.epa.gov/radiation/tenorm/sources.htm>

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TENORM Sources

- [Mining and Resource Extraction](#)
- [Energy Products](#)
- [Water and Waste Treatment](#)
- [Consumer Products Containing TENORM](#)

Mining and Resource Extraction

TENORM may be present in mining wastes. These wastes, most significantly from uranium mining, may be generated in large volumes and stored on land near the mine site. The waste rock and soil has little or no practical use. Uranium mine wastes from mines that closed before about 1975 are of particular concern. In many cases, these mines remain unreclaimed today, with the wastes piled near the mine as it was when the mine closed. Below is information about wastes from several resource extraction industries:

- [Uranium](#)
- [Fertilizer Production](#)
- [Aluminum](#)
- [Copper Waste Rock](#)

- [Gold and Silver](#)
- [Rare Earths](#)
- [Titanium Ores](#)

- [Zircon](#)

Uranium

The mining of uranium ores by underground, by [in-situ leaching](#), and by surface methods produces large and small amounts of bulk waste material, including excavated top soil, [overburden](#) that contains no ore, weakly uranium-enriched waste rock, and subgrade ores, and evaporation pond sludges and scales. These materials typically contain radionuclides of radium, uranium, and thorium.

Materials	Radiation Level [pCi/g]
	low average high

Uranium Mining Overburden			low
Uranium In-Situ Leachate Evaporation Pond	3	30	low hundreds
Solids	300		3000

Fertilizer Production

The production of phosphates for fertilizer generates wastes in very large volumes that are stored in huge piles called "stacks" that cover hundreds of acres in Florida and other phosphate-processing states. These radioactive materials contain radium and other radionuclides and create large amounts of radon. EPA and state agencies have regulations controlling these wastes. In addition, the state of Florida has created an independent state research agency charged with investigating ways to minimize adverse environmental impacts of the phosphate industry.

Materials	Radiation Level [pCi/g]		
	low	average	high
Phosphate Ore (Florida)	7	17.3-39.5	6.2- 53.5
Phosphogypsum	7.3	11.7-24.5	36.7
Phosphate Fertilizer	0.5	5.7	21

Aluminum

Waste muds created by the extraction of alumina from its ore, bauxite, may contain low levels of radioactivity, usually from uranium, thorium, radium, and their radioactive decay products

Materials	Radiation Level [pCi/g]		
	low	average	high
Ore (Bauxite)	4.4	NA	7.4
Product		0.23	

Production Wastes NA 3.9-5.6 NA

Copper Waste Rock

Mining and extraction of copper by common surface or underground methods can concentrate or expose uranium, thorium, and radium in waste rock. Another extraction method, known as "in-situ" leaching, can transport uranium and thorium into groundwater or surface water at the site. In this method, rather than removing soil and rock to reach the copper deposit, liquids containing chemicals are allowed to seep through copper-bearing rocks and dissolve the copper. It also dissolves radionuclides that may be in the soil and rock. The liquids are captured and the copper is recovered, leaving the radionuclides. Some of the liquids remain and may contaminate water in the area. In-situ leaching may also be used on tailings (waste rock).

Wastes	Radiation Level [pCi/g]		
	low	average	high
Copper Waste Rock	0.7	12	82.6

Gold and Silver

While few studies have been done on these ores, some western mines produced uranium as a secondary product when extracting precious metals. Pitchblende (a naturally occurring material containing low concentrations of uranium) has been found in the same ores as gold and silver. Waste rock from some of these mines may be radioactive.

Rare Earths

Rare earths are a group of elements that have electrical properties that make them useful in electronics and electrical applications. Lanthanides and yttrium are recovered primarily from ores and minerals that naturally contain uranium and thorium. As a result, the waste rock and sludges from the extraction of rare earths also contain these radionuclides.

Materials	Radiation Level [pCi/g]		
	low	average	high
Rare Earths(Monazite, Xenotime, Bastnasite)	5.7		3224

Titanium Ores

Uranium, thorium, and radium commonly occur in titanium ore and monazite occurs in sands from which the titanium is extracted. As a result, the mineral sludges, dusts, and sands from the extraction process may be radioactive.

Materials	Radiation Level [pCi/g]		
	low	average	high
Titanium Ores	8.0		24.5
Rutile	3.9	19.7	NA
Ilmenite	NA	5.7	
Wastes	3.9	12	45

Zircon

Zircon is naturally radioactive, containing small amounts of uranium, thorium and radium in its crystalline structure. It is also mined from deposits containing other radioactive minerals such as monazite.

Materials	Radiation Level [pCi/g]		
	low	average	high
Zircon	68		
Wastes	87		1300

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Energy Production Wastes

- [Coal and Coal Ash](#)
- [Geothermal Energy Waste Scales](#)

